3d Year Design ELO 5 / 8

# Overview

This document provides clear definition on the allocation of ELO 5 and ELO 8

# Exit Level Outcome 5

## Engineering methods, skills, tools, including Information technology

Use appropriate techniques, resources, and modern engineering tools including information technology for the solution of well-defined engineering problems, with an awareness of the limitations, restrictions, premises, assumptions and constraints.

*Each student will draw up an* ***ELO 5 Report*** *to show how this Exit Level Outcome has been addressed by following the guidelines as set out below. Each student must formally indicate an engineering methodology that was followed based on the system breakdown and work allocation (called a “****Scope of Work****” that clearly defines both the technical and project management work to be done). These ELO 5 Reports shall be presented as part of the* ***Design Portfolio*** *2017 and will be assessed according to criteria as defined in the Assessment Sheet for ELO 5.*

***Importantly,*** *each student will include in her / his* ***ELO 5 Report*** *a one-paragraph discussion under the heading “****Assumptions and Constraints****” with clear description of awareness of the limitations, restrictions, premises, assumptions and constraints that became apparent when using the methodologies and tools as indicated below. Failure to do so will result in failure of ELO 5.*

## Range Statement

A range of methods, skills and tools appropriate to the discipline of the program including:

1. Sub-discipline-specific tools, processes or procedures;

*Software designers will use a* ***development environment*** *for code development. This shall be accompanied by* ***flowcharts*** *and* ***state diagrams*** *that must be included in an individual* ***ELO 5 Report****. The following engineering procedure will be used:*

* *Define functionality of code (using a functional analysis)*
* *Draw up flowcharts / state diagrams*
* *Code according to flowchart / state diagram, compile and debug*
* *Test code individually according to functional analysis*
* *Integrate and test code for total product*
* *Demonstrate functionality*

2. Computer packages for computation, simulation, and information handling;

*Power supply / Hardware designers* ***must*** *use a* ***simulation*** *tool to simulate a DC/DC power supply and / or LED light driver. Simulations will be included in an individual* ***ELO 5 Report****. The following engineering procedure will be used:*

* *Define functionality of hardware (using functional analysis)*
* *Draw simulation circuits in simulation environment*
* *Simulate circuit and record all critical parameters (that can be measured)*
* *Build and test circuit individually according to functional analysis*
* *Integrate and test unit for total product*
* *Demonstrate functionality*

3. Computers and networks and information infrastructures for accessing, processing, managing, and storing information to enhance personal productivity and teamwork;

*Excel (for productivity) - All members will keep track of progress by using Excel to document the work breakdown (i.e. allocation of work to each memeber) and individually keep track of progress on a WEEKLY basis. Software version control must be done in a software package (such as Git) to ensure team efforts and software are managed. Progress tracking charts and work allocation (on the spreadsheets) must be included in the* ***Excel Project Management*** *document as proof.*

4. Basic techniques from sustainable development, economics, management, and health, safety and environmental protection.

*All students will, individually, indicate how* ***safety*** *decisions were addressed as a requirement in the design (i.e. allocated to each individual’s functional unit that was developed). This must be presented in the* ***ELO 5 Report*** *but will also appear in the* ***Design Documentation*** *of the* ***Design Portfolio***

# Exit Level Outcome 8

## Individual and Teamwork

Demonstrate knowledge and understanding of engineering management principles and apply these to one’s own work, as a member and leader in a technical team and to manage projects.

## Range Statement

1. The ability to manage a project should be demonstrated in the form of the project indicated in ELO 3 or ELO 4.

*3d Year Design was selected as the module in which Individual and Teamwork will be assessed. Therefore, all students will show how individual work and teamwork have been addressed. An ELO 8 Report will be included based on the guidelines provided below, containing the following:*

* *Each student’s individual Technical work as well as each student’s individual Project Management work, as outlined below;*
* *The team’s integrated Technical work as well as the team’s combined Project Management work, as outlined below.*

2. Tasks are discipline specific and within the technical competence of the graduate.

3. Projects could include: Laboratories; Business plans; **Design** etc

* *The* ***design*** *of systems and products to address a social need will be used to define products within the technical ability and capacity of the graduates. In 2017, an affordable Alarm System and an affordable Power Block will be developed.*

4. Management **principles** include:

* **Planning**: set objectives, select strategies, implement strategies and review achievement.
* **Organising**: set operational model, identify and assign tasks, identify inputs, delegate responsibility and authority.
* **Leading**: give directions, set example, communicate, motivate.
* **Controlling**: monitor performance, check against standards, identify variations and take remedial action.

## Rationale

*The development of a system or product will be done using two main elements of development, namely (i) Systems Engineering and (ii) Project Management that, combined, form a basis for delivering on ELO 8. For each of the principles above, there will thus be a technical and project side, respectively as defined below.*

*Systems Engineering / Technical work focuses on all technical aspects of the system or product, including defining the functional architecture and behaviour of the system and its elements. Work will be allocated based on the functional definition of the system.*

*Project Management work focuses on all cost, time and human resource aspects of the project, including system / product costing, development schedule and time management, and human resource management – i.e. work allocation and management of effort.*

## Principle 1 – Project Planning

*Planning will be done using Excel as a tool for management to address (i) teamwork and (ii) individual work. An Excel template for project management will be discussed in a lecture – the students will include printouts of Excel worksheets in the* ***Design Portfolio*** *to show how planning was done under the heading “****Excel Project Management****”. The Excel Project Management spreadsheet will have the following worksheets:*

1. *Project: Including System Breakdown, Work Allocation, Project Schedule, Project Progress tracking, Minutes of Meetings as placed under appropriate headings;*
2. *Member A / B / C;*
3. *Minutes of meetings;*
4. *Risks and mitigations.*

### Technical planning

***Teamwork*** *will be addressed using Functional Analyses to define the system upon which must be delivered. Teamwork is addressed when team members collaborate to define the functional scope of the overall system / product including all* ***integrated*** *functional units, functional flows and interfaces. Clear labelling must be done on a* ***System Breakdown*** *to ensure work can be allocated by referring to functional units – also show software building blocks that must be developed.*

***Individual work*** *will be addressed also using Functional Analysis to define each team member’s* ***specific*** *functional unit / sub-system that must be developed. This may be a mechanical / electrical element (such as a particular power supply module, embedded processer controller or the like) or software (such as a user interface, communication module or the like). Each member will also clearly indicate for which interface she / he is responsible.*

### Project planning

***Teamwork*** *will be done using the* ***System Breakdown*** *(technical aspects) to allocate work to team members in a* ***Work Breakdown*** *(work aspects). Collaborative efforts associated with teamwork include the following:*

* *Overall time, cost and resource planning where work is allocated to members – this is done in the Excel spreadsheet;*
* *Weekly meetings where work progress is tracked, decisions are made, and risks are identified and addressed – evidence of* ***Progress Tracking*** *will be provided in the* ***Excel Project Management*** *spreadsheet.*

***Individual work*** *will be done where each member plans her / his own work in terms of time schedule and cost. This must be presented in the* ***Excel Project Management*** *worksheet specific to the team member’s development effort.*

## Principle 2 – Project Organization

*Organization is done by allocating tasks and resources in an optimal manner.*

***Technical*** *organization is most easily achieved by doing a Functional Analysis and allocating team member (human resources) according to* ***expertise****. Responsibility for interfaces may be assigned to result in work load that is* ***fairly distributed****. Students must provide evidence that these decisions were made during planning by indicating each member’s expertise in the Excel spreadsheet that will be included in the* ***Design Portfolio****.*

***Project*** *organization ensures the development process is logically defined, schedules are achievable and sensible by following the development process, and cost is sensibly allocated to functional units as agreed by the team. A sensible development process with associated timeline will be sufficient proof of project organization.*

## Principle 3 – Project Leadership

*Leadership will fall under Project Management where students will be taking on management / leadership on a* ***rotational*** *basis. Evidence will be provided in weekly Minutes of Meetings included in the* ***Excel Project Management*** *spreadsheet in the* ***Design Portfolio****. Date, time, attendees,* ***name of chairman****, issues / risks and decisions must be evidenced in each set of Minutes. Taking ownership of project issues and risks is implied in the rotational management methodology and is clear evidence of leadership.*

## Principle 4 – Project Control

*The project will be controlled using the two elements of management, namely Technical Control and Project Control.*

### Technical Control

*Control over the system / product’s technical aspects is achieved by:*

* *Defining and monitoring technical performance of the system. That is, each function must be performed to a predefined performance level as defined by the system requirements and specifications. The activity of testing performance against the design specifications (that must be drawn up by teams) is thus a form of technical control. In order to achieve this, each team will define the system’s functions and their performance levels formally in a* ***System Specification Document*** *that will be included in the* ***Design Portfolio****. The* ***System Specification Document*** *will contain (i) functional specifications, (ii) performance specifications, (iii) environmental specifications, (iv) physical specifications, (v) interface specifications, (vi) safety specifications, and (vii) disposal / recycling. Additional specifcations may be included, but the listed specifications above will be the minimum requirement.*
* *Each member will also present her / his own specification document for the sub-system / module for which that member is responsible. This will be the* ***Sub-system Specification Document*** *and will include the same headings as the System Specification Document and will thus contain specifications that must align with the System document. Each member will provide a* ***Sub-system Specification Document*** *to be included in the* ***Design Portfolio****.*
* *Variations must be managed by means of change control. Technical changes must be minuted in the* ***Minutes of Meetings*** *as part of “Issues / Risks” and must be managed by identifying the impact of a change and its associated remedial action. These Minutes will be included in the Excel Project Management spreadsheet as part of the* ***Design Portfolio****.*
* *Standards will be used by referring to* ***SAIDSA Bylaw 25 security standards****. These standards are available at the SAIDSA web site and will be used to provide input to the design. Deviations from this standard will be discussed and waivers (allowance for non-compliance) will be discussed in lectures. These standards are actually also binding in a legal sense as they are included in a bylaw.*

### Project Management Control

*Team members’ efforts must be controlled as follows:*

* *Project performance is controlled by tracking work progress. This is done on a weekly basis in the Excel Project Management spreadsheet where the project’s progress, as well as each team member’s progress, will be tracked. These must be included in the* ***Excel Project Management*** *spreadsheet under* ***Project Progress*** *and* ***Member Progress****. This will be included in the* ***Design Portfolio****.*
* *Project variations are managed as part of Issues / Risks as these will impact project schedule. Variations are thus managed on a weekly basis. Teams are required to show the Risk / Mitigation register (the relevant worksheet in the* ***Excel Project Management*** *spreadsheet) to be included in the* ***Design Portfolio****).*

Design Portfolio

# System Operational Requirements (Team)

## Functional Analysis – Operational Level Architecture and Behaviour

### System Operational Architecture (Operational Layout Diagram)

### System Operational Flow (Functional Flow Diagram – Life Cycle)

## Physical Requirements (Form)

## Interface Requirements (Fit)

## Additional requirements

### Environmental Requirements

### Safety Requirements

### Legislative Requirements (SAIDSA Bylaw 25)

### Usability Requirements

# Excel Project Management Documents (ELO 8)

## Combined Project Documents (Team)

## Risk / Mitigation Register (Team)

## Minutes of Meetings (Team)

## Member A

### Excel Project Management Documents (Member – Refer to Excel Spreadsheet)

### Experience Report (1 Page – Individual and Team Contribution Defined)

## Member B

## Member C

# Engineering Methods / Skills / Tools (ELO 5)

## Member A - ELO 5 Report (Member)

### Scope of Work

### Assumptions and Constraints

### Discipline-Specific Engineering Methodology

### Simulations / Flowcharts / State diagrams

### Physical Tests / Measurements (Explanation of Test Results)

### Health and Safety Considerations (Full Life Cycle)

### Discussion of Tools Used to Enhance Productivity (Excel / Git)

## Member B - ELO 5 Report (Member)

## Member C - ELO 5 Report (Member)

# Sub-system Specification Documents (Members)

## Member A

### Sub-system Functional Analysis (Architecture / Flow) – Requirements Allocated

### Sub-system Interface Definitions (Aligned with ICD)

## Member B

## Member C

# Design Documentation

## System Design Documentation (Team)

### Final System Functional Definition (Function) – Requirements Allocated

### System Concept Drawings (Form)

### System Interface Definitions (Fit - Interface Control Documents - ICD)

### System Integration Testing

## Sub-system Design Documentation (Member)

### Technology Survey / Datasheets

### Application Notes

### Trade-off Studies / Decision Making / Technology Selection (Decision Matrix)

### Design Drawings (Hand Drawings and CAD)

### Behavioural Modelling (Simulations / State Diagrams / Flowcharts as for ELO 5)

### Design Implementation (Software Code / Hardware)

### Sub-system Test and Evaluation (Procedure / Setup / Results as for ELO 5)